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# **FUTURE WAR PAPER**

Title: Air Mechanization, and the Coming  
Obsolescence of  
Medium, Heavy Lift Helicopters and the C-130

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### Abstract

This paper is about an emerging aircraft design and what its capability may mean to warfighters in the near future. The central theme of this paper is that existing aviation platforms, namely medium/heavy lift helicopters and C-130 type aircraft, significantly limit the utility of vertical envelopment as a viable technique for today's military commanders. Mobility considerations have always constrained an operational commander's ability to achieve decision. Technological capabilities exist today which may significantly improve the operational and tactical mobility, survivability and lethality of the light forces of tomorrow. When current aircraft are replaced by improved heavier tilt rotor aircraft in the next 15-20 years they will become obsolete as a means of air mobility.

Tilt rotor aircraft are the coming wave of technological innovation for aviation, it will make vertical envelopment a viable operational form of manoeuvre for the very first time. The advantages in speed, range and payload that it offers will revolutionize the manner in which air assault operations are conducted. Clearly, operational concepts and doctrine will need to be refined to exploit this potential capability; however, the nations which do embrace this coming change will have a significant advantage over their adversary's in both the conventional and unconventional fight.

*They will clear the way for tremendous victories...their swift thrusts, aimed deep into enemy territory, will cause the enemy's swift collapse, the way the fall of a pillar sometimes can bring a cathedral to the point of collapse.*

Colonel Charles de Gaulle, 1934<sup>1</sup>

## Introduction

In 1934 de Gaulle was envisioning the future impact of highly mobile mechanized forces on warfare which the world witnessed during World War II. Today, similar possibilities are emerging in the realm of air mobility which may well have a significant impact on future warfare. This paper is about an emerging aircraft design and what its capability may mean to warfighters in the near future. The central theme of this paper is that existing aviation platforms, namely medium/heavy lift helicopters and C-130 type aircraft, significantly limit the utility of vertical envelopment as a viable technique for today's military commanders. When current aircraft are replaced by improved heavier tilt rotor aircraft in the next 15-20 years they will become obsolete as a means of air mobility. Tilt rotor aircraft will fundamentally alter the character of vertical envelopment, as we know it today, making it for the first time a truly viable form of manoeuvre.

While tilt rotor aviation is not new, these type of aircraft designs have been around since the 1950s, only one has ever gone into production for military forces.<sup>2</sup> The recent US government decision to go into full production of the MV-22 Osprey for the USMC marks a watershed moment for the future of military aviation. It is not this author's contention that the V-22 itself will be revolutionary; but rather, that it is the first of its kind and may well lay the groundwork for the exploitation of far more capable aircraft of its type in the future. Just as the initial British employment of the Mark 1 tank at the Battle of the Somme in 1916 demonstrated the possibilities of tracks for future warfare, so may be true of the MV-22 and the future of tilt rotor aviation.

## The Military Problem

Currently most modern military forces, to varying degrees, are capable of projecting either highly mobile or lethal medium/heavy ground forces relatively slowly; or rather quickly deploying moderately lethal and highly vulnerable light forces with very limited tactical mobility. The two different types of forces available to operational commanders today have an essentially dialectical relationship based on a trinity of mobility, protection and lethality. To put this relationship in perspective; the argument would be that medium and heavy weight forces, while strategically slower to deploy, bring the survivability, tactical mobility and lethality necessary to win wars. The anti-thesis would be that lighter forces, either airborne or heliborne, while more highly mobile both strategically and operationally, lack tactical mobility, have limited protection and are only moderately lethal once they are delivered and lack an ability to win wars.

This paper seeks to define a possible synthesis, one which combines the mobility of light forces with the lethality and survivability of heavier forces. The mobility and survivability of the light forces of today, particularly in a 'vertical envelopment' role, once they are on the ground, is no better than that of a World War II airborne force and probably inferior to the Soviet 1980's heliborne capability. That is to say, the vast majority of the combat forces are foot mobile after landed, moving at a speed of 2-3 miles per hour, and weighed down by combat loads far in excess of what their forbears had to carry. If the added mobility assets delivered by gliders is considered, perhaps today's force is even less mobile than a typical World War II airborne division.

This paper will not; however, propose the re-introduction of gliders. Rather, it will suggest that a synthesis is possible, one which leverages the strengths and mitigates

some of the limitations, of light forces by enabling their mobility through larger tilt rotor aircraft, capable of transporting both troops and vehicles to the battlefield. That is to say, it is possible to develop a capability to deliver highly mobile, reasonably well protected, lethal light forces over strategic distances at great speed through the use of large tilt rotor aircraft such as the experimental V-44. These types of aircraft are currently on the drawing books of both Bell and Boeing for possible application to the US Army's Joint Heavy Lift program and one is depicted on the title page to this paper.<sup>3</sup>

### Current Platforms

The current inventory of transport helicopters, CH 47 and CH 53 types, are based on Vietnam War era designs. While they may have met the requirements of the past, it is doubtful that they will be able to meet the mobility requirements of the future. Without trying to be overly technical, which is beyond the capability of this author and the space available in this paper, helicopters possess three inherent limitations which degrade their utility with respect to air mobility. First is their limitation in speed, modern helicopters are limited to cruise speeds of about 150-170 knots.<sup>4</sup> A second limitation is their actual cruise capability, both in range and altitude. That is to say, without dedicated re-fuelling capabilities they do not possess nearly the range of turbo-prop or tilt rotor type aircraft, nor do they typically have an ability to operate at an equivalent altitude, 20, 000 feet +, that turbo-prop and tilt rotor aircraft can. Additionally, the current platforms are incapable of lifting more than 25,000-32,000 pounds. Each of these limitations, while disadvantageous in and of themselves, together create a highly negative synergistic effect.

In effect, helicopters are slow and vulnerable, relatively short range and limited by insufficient payload to delivering a principally dismounted force. In other words, at best, with them a military force can be delivered over tactical distances by a means that is very vulnerable in flight, and once air landed the force is highly vulnerable and of limited utility beyond holding the ground upon which they were landed. The problem is that once the force is delivered with the current family of aviation it is principally a foot borne light infantry force with some very light support vehicles with almost no armoured protection at all. So how will this force move on the future battlefield? The point is, it will have hardly any more tactical mobility than an airborne force of World War II vintage, or even that of a Roman legion from 2000 years ago. Indeed, it will only be capable of moving its main body at 2-3 miles per hour without continuous repositioning by more aviation. This is hardly an advantage, and in fact this highly strategically and operationally mobile force may in fact become as much a liability to an operational commander as it may be an asset.

Some would argue that the limitations of helicopters could be compensated for by using C-130 type aircraft, an airplane which was first brought into service in the 1950s. Certainly, there was much talk of this in the post Gulf War 1990s, when the development of a medium weight capability for the US Army in the form of Light Armoured Vehicles was seen as a potential way of increasing the firepower, mobility and protection of light forces. It was envisioned that these new medium weight vehicles would be air-transportable by C-130. However, the current inventory of Stryker vehicles, developed to meet these requirements, is clearly not ideally air-transportable by current tactical air platforms. Some also articulated concepts of employment which envisioned the

possibility of special operations forces or airborne forces seizing airheads upon which the remainder of a follow-on force could then airland. However, a significant limitation of a C-130 is that it requires 2,300 feet of runway. Thus, it is incapable of operating in areas where it would be required to be able to operate off of short, unprepared runways and, of course, it has no vertical take off capability. Therefore, while it may have good range and payload capability, it is limited by where it may be landed, thus limiting its flexibility as an air mobility asset. It wouldn't take an overly clever opponent to be able to figure out potential landing sites and then take actions to preclude their use. Thus, while a valuable intra-theatre lift asset and a possible means of inserting follow on forces, C-130 type aircraft are really not suited for employment in an assault support role.

Unlike the C-130, tilt-rotor aircraft combine the vertical take off and landing ability of helicopters and the speed and range of a large turbo-prop transport.<sup>5</sup> The model currently coming into service is the MV-22 for the Marine Corps and the CV-22 in the Air Force, primarily for use by Special Operations Command. While the V-22 offers a tremendous capability, its speed is achieved at the expense of payload.<sup>6</sup> Capable of top speeds over 300 knots and a payload of only 10,000 pounds of internal or external payload it will deliver fundamentally the same type of force as current generation helicopters, only much faster with less vulnerability, and over far greater range. What it will not do is alter the nature of 'vertical envelopment' forces capability, other than being able to deliver them farther and faster to deeper objectives. This is a laudable achievement, but once again the air-landed force will be principally dismounted and vulnerable. Simply put, the V-22 is too small and narrow and must therefore rely on additional assault support aviation, such as CH-47 and CH-53s, to do the heavier lifting.

This is its critical failing, as it will be necessary for the V-22 to be employed within the operational range and capabilities of its heavier and slower cousins, thus negating any potential operational mobility increase its greater speed and range could have delivered. Without a doubt it will be a useful evolutionary improvement in assault support capability, but it will not make ‘vertical envelopment’ any more viable as an operational technique than it is today.

A quad tilt rotor aircraft, on the other hand, does fundamentally change the potential for vertical envelopment. Imagine an aircraft that can deliver 2-3 times the payload of a V-22, with eight times the internal volume capacity, and an ability to do all of this at speeds in excess of 300 knots and a range of up to 2,000 nautical miles. It will essentially be an aircraft which can deliver C-130 size payloads to the most austere landing sites possible, without the need for runways or airports. It would allow the assault delivery of both troops and vehicles; to move, protect and sustain them, all in the same platform. While this may sound like a pipedream, it is not. There are designs being developed by both Bell and Boeing which will build on the technology designed for the V-22, called the V-44 and V-66, which envision quad or more tilt rotor aircraft, which have been nicknamed “flying freight cars”.<sup>7</sup> These aircraft could also operate off of amphibious ships and aircraft carriers. Given the maturity of tilt-rotor aviation technology, it is reasonable to expect these aircraft to be available in the next 15-20 years if a military requirement was written for them.<sup>8</sup>

#### Air Mechanization Defined

Before discussing current operating concepts, and the potential application of enhanced rotary wing aircraft to them, it is important to recognize that air mechanization

is not a new operational concept. First viewed by former Soviet theorists as a method of delivering lightly armoured forces to the operational depth of the battlefield, air mechanization has largely been ignored as a concept since the end of the Cold War. As Simpkin states, Tukhachevskii pioneered mechanised airborne troops in his earliest thinking on deep operation theory. Accordingly, the Soviet Army developed airborne armoured vehicles in the 1960's and by the 1980's had entirely mechanized airborne divisions.<sup>9</sup> The central idea is that the gain in operational depth and tempo, and an ability to move dispersed and fight concentrated, makes up for the relative lack in mass of the force.

Fortunately, the West never got to experience the capability of Soviet deep airborne or heliborne troops, but their lack of use does not invalidate the concept. Having said that, as previously discussed, the current fleet of aviation assets are not suitable to deliver air mechanized forces as the rotary wing assets necessary to lift these types of payloads would be too large, slow and hence vulnerable.

#### Application to Current Operating Concepts

A military concept can be defined as “a description of a method or scheme for employing specified military capabilities in the achievement of stated objective.”<sup>10</sup> This paper will focus on the application of a greater tilt rotor capability to two existing United States Marine Corps (USMC) operating concepts; namely, Distributed Operations and Ship-to-Objective Maneuver. Clearly, the development of tilt rotor aviation and the operating concepts was not a sequential process, as the United States military has been developing the V-22 as a replacement to the CH-46 since the early 1980's and the operating concepts themselves are much more recent.<sup>11</sup> Which came first is not

particularly relevant in this case, as the intent here is merely to demonstrate some shortfalls in current USMC operating concepts, and how a quad tilt rotor may redress these deficiencies.

The USMC describes Distributed Operations as:

... an operating approach that will create an advantage over an adversary through the deliberate use of separation and coordinated, interdependent, tactical actions enabled by increased access to functional support, as well as by enhanced combat capabilities at the small unit level. The essence of this concept lies in the capacity for coordinated action by dispersed units, throughout the breadth and depth of the battlespace.<sup>12</sup>

The concept envisions units which operate in a “disaggregated fashion” with “significant combat power, enabling them to locate, close with and destroy the enemy.”<sup>13</sup> The challenge is, just how are these dispersed units supposed to spread out across the depth and breadth of the battlespace, then close with and destroy the enemy or ‘re-aggregate’ for decisive operations. As the concept acknowledges, to effectively manoeuvre these small units as envisioned will require both air mobility and organic vehicles for ground mobility.

One apparent answer is to ensure that the force that is to be delivered across the depth and breadth of the battlespace, does so by a means which can deliver both the troops and their organic transport in one platform. This will negate the requirement to seize airheads, and at the same time deliver a force with its own organic ground transport which will enhance the mobility, lethality and survivability of the force.

As has been demonstrated in the earlier discussion on aviation platforms, there is nothing in the projected inventory which is ideally suited for this purpose. To deliver the type of force envisioned will require a combination of air assault support and air landed

delivery of organic vehicles. The complexity of this type of operation, requiring the seizure of airheads, before the forces can disperse, may well preclude it from being practical. Conversely, if it is decided to try to carry out these types of operations without organic transport, the air assaulted force will potentially be at a significant mobility disadvantage relative to an adversary. They will probably be out of mutual support range, highly vulnerable to the effects of indirect and direct fires and will be incapable of quickly re-positioning themselves to adapt to a changing situation. Likewise, they will probably be equally difficult to sustain, as they will be reliant on what they can carry and what can be air delivered to them. How then can you mitigate the risk to such forces, and still have the desired effect?

The carrying capacity of a V-44 quad tilt rotor type aircraft is ideally suited to this end. With a 'flying freight car' platoon size elements, with organic transport, could be delivered at great range and dispersion across the battlespace. They would have the integral transport necessary to move around the battlespace, while reasonably protected, and of course, the vehicles will be capable of carrying communications and weapons which will significantly enhance their situational awareness, lethality, survivability and sustainability. Thus, they will be able to arrive in a widely dispersed and 'dis-aggregated' fashion, and once the enemy is located, they can then move to 're-aggregate', close with and destroy the enemy.

To be fair, Distributed Operations is a viable operating concept and is early in its development. However, before it can be employed as a viable form of concept of operations, the issue of air mobility and organic vehicle support will need to be resolved.

The use of quad tilt rotor aircraft seems to offer a practical solution to the challenges of Distributed Operations.

Closely related to the concept of Distributed Operations is the concept of Ship-to-Objective Maneuver. It shares many of the same challenges as the previously discussed operating concept because it also places a heavy, although not exclusive, emphasis on air mobility.

The *sine qua non* of power projection and strategic mobility will continue to be an increasing reliance on seaborne expeditionary forces. Previously largely the purview of the United States military, most countries that can afford it have been recently expending, or are about to begin to expend, an increasing amount of their defence budget on amphibious shipping. The United Kingdom, Italy, Spain, the Netherlands, South Korea, Australia, India, Canada and France are only a few of the countries that have made considerable investment, or are about to, to upgrade their amphibious capability. These nations clearly recognize, like the United States has since the time of Mahan, that most of the potential crisis and conflict areas of the future are accessible from the sea and freedom of navigation of the world oceans allows seaborne forces to travel to and maintain watch over crisis areas. Three quarters of the world's surface is covered by water, estimates state that 70 percent of the world's population and 80 percent of the world's capitals are within 160 kilometres of a coastline.<sup>14</sup>

Seaborne forces offer far greater flexibility for an operational commander to decide the time and place to offer battle. However, there is a price to be paid when it comes to tactical mobility. While the over the shore forcible entry of landing forces brings the most combat power it also brings a large and vulnerable logistics tail, and

imposes constraints on the operational commander with respect to the time required to build up sufficient combat power ashore. Indeed, the Marine Corps' current concept of Ship-to-Objective Manoeuvre (STOM) is predicated on the belief that large scale classical landing operations are a thing of the past; instead it envisions a force able to manoeuvre straight to operational objectives from the sea. The MV-22 is seen as a critical enabler of this capability; however as the MEB 2015 study has pointed out the MV-22 alone is not capable of the heavy lift necessary to sustain a STOM capability once it is ashore.<sup>15</sup> Thus, it identifies a greater need for medium and heavy lift aviation assets to operate in concert with an MV-22 delivered force.

Again we're drawn back to the previous discussion about platforms and the fact that there is a requirement for a heavy lift aircraft to be able to exploit the advantages of speed and range offered by the MV-22. It makes little sense to have to reduce the employment of the full potential of the MV-22 simply because of a need to rely on slower, larger and more vulnerable helicopters. Instead, what is required is a heavy lift capability that can operate either in concert, or independantly, with the MV-22 to fully exploit the manoeuvre potential and deliver air mechanized forces directly to operational objectives across the depth and breadth of the battlespace from the sea. This is a capability that a quad tilt rotor aircraft, such as the V-44, would enable.

#### An Illustrative Example

If the recent past is any guide to the possible future, it seems evident that warfare will be fought by western nations in an increasingly expeditionary manner, in austere and harsh environments, with somewhat rudimentary infra-structure where mobility will almost always be a significant military issue.

Clearly capabilities, to have relevance, will need to be employable across the spectrum of conflict. The advantages in a symmetrical conventional conflict of having a truly viable deep ‘vertical envelopment’ is almost intuitive, and has been already alluded to in this paper. Therefore, the illustration will focus on an unconventional war construct. It will take a look at the mobility limitations of the British task force in Southern Iraq’s Maysan province which is severely limited by their lack of air mobility. As a result of a decision to pull out of firm bases in the Al Amarah area in August of this year, and the enduring need to continue re-supplying their troops patrolling the border, the British have been forced to begin constructing austere airfields in the desert, so they can fly in re-supply. It is only a matter of time until the methodology is figured out by the insurgents. This technique may work for a time in the desert, but would be impractical in most other environments.

Alternatively, look at the opportunities they would have if not for the imposed reliance on C-130s to sustain their forces. They could be patrolling along the border at will by inserting, extracting and re-supplying forces across the depth and breadth of Southern Iraq if they had an aircraft that could move troops and vehicles together. The point is, force protection and tactical mobility is just as much an issue in counter-insurgency operations as it is in conventional operations.

#### Some Possible Implications

The United States military is the only one with the financial resources to fund the introduction of such a revolutionary capability. That is not to say other nations wouldn’t follow in trace, as they have with the Joint Strike Fighter program, but rather simply no

other military has the resources to initiate a program of this nature. Therefore, the possible implications listed below focus on the four United States military services, but could apply in varying degrees to other countries as well.

Army/Air Force. The US Army will soon need to replace its aging CH-47 fleet, and it is therefore likely to be the largest potential customer for the quad tilt rotor if it is acceptable to the US Army's Joint Heavy Lift program.<sup>16</sup> Therefore, in all probability, it is the US Army that will decide, based upon its requirements, whether or not quad tilt rotor aircraft get produced. The US Army is the only service not permitted to fly fix wing aircraft. This will most likely be a source of inter-service friction with the US Air Force. Regardless, as the aircraft would be flown in a direct support mission, it is reasonable to expect that it would be resolved in the favour of the US Army.

Another program that needs to be closely linked with is the Future Combat Systems program. Obviously, the future aircraft must be capable of moving the troops and vehicles being designed for the future, or else the aircraft would be a senseless program. Also, the organisation for light forces formations and the doctrine for air assault and vertical envelopment as a whole will need to be re-visited due to this change in capability.

Marine Corps. While probably not the largest client, the Marine Corps arguably has the most to gain from such a program. The introduction of a quad tilt rotor capability would be extremely beneficial to any force air assaulting from the sea. The reason for this is simple, without this type of capability, the operating concepts of Distributed Operations and Ship-to-Objective Maneuver will remain in the conceptual stage. Both are heavily reliant on a requirement for air mobility and organic vehicles to be air delivered.

The capability to do this is currently limited, and operating across the depth and breadth of the battlespace as envisioned by the Marines is not feasible given current capabilities.

Marine small units, and sub-units are typically larger than most army like type organisations. Given the limited physical space available, depending on the type of quad tilt rotor and future combat systems vehicles that may be acquired, these organisations will probably have to get smaller. It would not be advantageous to have to cross load organisations across numerous aircraft if unit integrity could be maintained without reducing the lethality of the organisation. Like the Army, Marine Corps doctrine and organisations will also need to be adapted; although it could be argued that the Marine Corps is already much further ahead than the Army because it at least will have a conceptual basis and body of experimentation, from Distributed Operations and Ship-to-Objective Maneuver, on which to base its modification.

Navy. The principal issue for the Navy would most likely be how will it integrate with the concept of Seabasing, in other words, are the big decks big enough? Resolving these issues will require operational research and experimentation; however, it seems reasonable that it can be made to work. A few of the possible options might be forward positioning aircraft in the same manner as pre-positioned shipping, making use of intermediate staging bases as mounting areas then linking up with the assault elements over the horizon at a Seabase, or possibly using aircraft carriers to stage off of. Given the improvements likely to take place in Seastrike and space based weapons capabilities in the next 15-20 years, perhaps some carriers would be more useful as assault support platforms than strike platforms anyway.

## Conclusion

While it is impossible to predict, with any degree of certainty, what developments may be feasible and militarily useful 15-20 years from now, it is reasonable to project what may be in the realm of the possible. Mobility considerations have always constrained an operational commander's ability to achieve decision. Technological capabilities exist today which may significantly improve the operational and tactical mobility, survivability and lethality of the light forces of tomorrow. Indeed, it is feasible to predict that air mobility may undergo revolutionary improvement in the near future, much the same as mechanized and motorized forces did during the period between World Wars I and II.

Tilt rotor aviation is the coming wave of technological innovation for aviation, it will make vertical envelopment a viable operational form of manoeuvre for the very first time. The advantages in speed, range and payload that it offers will revolutionize the manner in which air assault operations are conducted. Clearly, operational concepts and doctrine will need to be refined to exploit this potential capability; however, the nations which do embrace this coming change will have a significant advantage over their adversary's in both the conventional and unconventional fight. Those who ignore this coming change, do so at their own peril.

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- <sup>1</sup> Karl-Heinz Frieser, Blitzkrieg Legend (Annapolis: Naval Institute Press, 2005), 263.
- <sup>2</sup> Steve Markman and Bill Holder, Straight Up: A History of Vertical Flight (Atglen, PA: Schiffer Publishing Ltd, 2000) 4-10.
- <sup>3</sup> Sandra I. Erwin, "Industry Titans Vying for Early Lead in Cargo Aircraft Markets," National Defense, February 2000, <http://www.nationaldefensemagazine.org> (February 2000). Accessed 20 November 2006.
- <sup>4</sup> "Tiltrotor", <http://www.wikipedia.org>. "A helicopter's maximum forward speed is defined by the speed that the rotor turns at; at some point the helicopter will be moving forward at the same speed as the spinning of the backwards –moving side of the rotor, so that side of the rotor sees zero or negative airspeed, and begins to stall. This limits modern helicopters to cruise speeds of about 150-170 knots." Accessed 21 November 2006.
- <sup>5</sup> National Defense, Industry Titans.
- <sup>6</sup> Tiltrotor, Wikipedia. "The two production tiltrotors flown so far have about half the payload of a helicopter with the same power and empty weight. As a result of its reduced payload, a tiltrotor does not exceed the transport efficiency (speed times payload) of a helicopter."
- <sup>7</sup> Popular Mechanics, "V-44: Pentagon's Next Air Transport article," September 2000, <http://www.popularmechanics.com> (September 2000).
- <sup>8</sup> National Defense Article,
- <sup>9</sup> Richard Simpkin, Race to the Swift: Thoughts on Twenty-First Century Warfare, (London: Brassey's Defence Publishers, 1985), 119.
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- <sup>12</sup> United States of America, Department of Defense, United States Marine Corps, Marine Corps Operating Concepts for a Changing Security Environment, 95.
- <sup>13</sup> USMC Operating Concepts, 96.
- <sup>14</sup> NATO Allied Joint Publication (AJP) 3.1, Allied Joint Maritime Operations, 1 October 2002, 1-1.
- <sup>15</sup> United States of America, Department of Defense, United States Marine Corps, USMC 2015 and Beyond MEB Study, (GS-35F-0646N), 10 July 2005. The most similar unit by Table of Organisation and Equipment in the aforementioned study is the Vertical Assault Battalion with LAVs. According to the MEB 2015 study this unit would consume approximately 60 tons of supplies daily, see Table 1, 30 tons of which would be fuel and water. To put this in aircraft loads that would equal 12 x Sikorsky H-92 or 4.5 x Boeing CH-47 SD sling loads daily.
- <sup>16</sup> Tiltrotor, Wikipedia.

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